Remarks

The Final Office Action mailed November 4, 2003 has been received and reviewed. No claims have been amended or cancelled. Therefore, claims 46 and 51-88 are pending in the present application. Reconsideration and withdrawal of the rejections are respectfully requested in view of the following remarks.

I. Whether claims 46 and 51-59 are patentable under 35 U.S.C. § 103(a) over Hayashi et al. in view of Berti et al.

The Examiner continues to reject claims 46 and 51-59 under 35 U.S.C. § 103 as being unpatentable over Hayashi et al. (U.S. Patent No. 5,482,895) and further in view of Berti et al. (U.S. Patent No. 5,567,651). Applicants respectfully traverse the Examiner's rejections.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. *See* M.P.E.P. § 2143.

Claim 46

Claim 46 recites a method of selectively etching a portion of a metal nitride region against a cobalt silicide region using a solution including a mineral acid and a peroxide, wherein the solution etches the portion of the metal nitride region at an etch rate in a range of about 50 Å/minute to about 250 Å/minute.

The Cited References Do Not Teach or Suggest All the Claim Limitations

The cited references do not teach or suggest all of the elements of claim 46, and therefore, claim 46 is not obvious in view thereof. For example, the cited references do not teach or suggest a solution including a mineral acid and a peroxide, wherein the solution etches

the portion of the metal nitride region at an etch rate in a range of about 50 Å/minute to about 250 Å/minute.

Hayashi et al. does not even teach use of a mineral acid and peroxide solution.

The Examiner recognizes that Hayashi et al. does not describe a solution containing a mineral acid to etch TiN, e.g., a metal nitride described therein. Further, as recognized by the Examiner on the top of page 3 of the Office Action, Hayashi et al. does not teach the etch rates for selectively etching metal nitride against cobalt silicide as described in claim 46 (i.e., 50 Å/minute to about 250 Å/minute).

In other words, and as recognized by the Examiner, Hayashi et al. does not even teach the use of a "mineral acid and peroxide solution" to etch metal nitride. As such, it is unclear how the Examiner can allege that "the etch rate of the metal nitride depends on the chemical concentrations, which would be result-effective variables, in the solution" of Hayashi et al. when the solution does not even contain the same components as the claimed solution. Further, it is unclear how "test runs" could be used to "achieve the optimum chemical concentration in the solution to etch the metal nitride with an expectation of a reasonable success" when the solution components are different than that claimed.

Berti et al. does nothing to provide the elements lacking in Hayashi et al.

Perhaps the Examiner meant to cite Berti et al. instead of Hayashi et al. and allege that "the etch rate of the metal nitride depends on the chemical concentrations, which would be result-effective variables, in the solution in which the concentration would have to be determined through test runs in order to achieve the optimum chemical concentration in the solution to etch the metal nitride with an expectation of a reasonable success."

If such is the case, it is noted that Berti et al. does not explicitly teach any etch rates. However, if such etch rates of Berti et al. are to be considered, then at least a general understanding of such etch rates is to be discerned from the given information in Berti et al.

For example, Berti et al. teaches removing unwanted cobalt and titanium nitride by immersing the wafer for 30 minutes in a mixture of phosphoric, acetic, and nitric acids and hydrogen peroxide. The thickness of the titanium nitride layer prior to silicidation is 50 to 150 Å. *See* Berti et al., column 3, lines 24-26. The thickness of the cobalt layer prior to silicidation 165 to 300 Å. *See* Berti et al., column 3, lines 17-18. If the entire described thickness of TiN and Co were consider (i.e., 450 Å), the maximum etch rate for both thicknesses would only be 15 Å/minute. However, it is indicated that at least a portion (and usually a substantial portion to reduce the amount of unreacted Co to be removed) of the Co is consumed during the silicidation process. Therefore, the 15 Å/minute rate is clearly much lower. As such, Applicant continues to argue that Berti et al. does not show the etch rates described in the pending claims and actually shows rates that are much lower than the claimed rates used according to the present invention.

Applicants continue to submit that the etch rates disclosed in Berti et al. cannot be ignored, and that the cited references must be viewed in their entirety. As such, the etch rates described in the pending claims are not taught or suggested by the cited references and because all the claim limitations of claim 46 are not taught or suggested, claim 46 is not *prima facie* obvious in view thereof.

There is no suggestion or motivation to combine the cited reference teachings to arrive at the claimed invention.

Claim 46 as stated above includes a solution that etches the portion of the metal nitride region at an etch rate in a range of about 50 Å/minute to about 250 Å/minute. Also, as stated above, Hayashi et al. is silent regarding etch rates and does not even teach the solution as set forth in claim 46. The addition of Berti et al. does nothing to correct this deficiency already present in Hayashi et al. In fact, the etch rates of Berti et al. teach away from using higher etch rates, especially considering the Examiner's suggestion that the solutions can be diluted with deionized water (see page 3 of Office Action last paragraph).

In other words, and as set forth above, Berti et al. teaches removing unwanted cobalt and titanium nitride by immersing the wafer for 30 minutes in a mixture of phosphoric, acetic, and

nitric acids and hydrogen peroxide. The thickness of the titanium nitride layer prior to silicidation is 50 to 150 Å. *See* Berti et al., column 3, lines 24-26. The thickness of the cobalt layer prior to silicidation 165 to 300 Å. *See* Berti et al., column 3, lines 17-18. If the entire described thickness of TiN and Co were consider (i.e., 450 Å), the maximum etch rate for both thicknesses would only be 15 Å/minute. However, it is indicated that at least a portion (and usually a substantial portion to reduce the amount of unreacted Co to be removed) of the Co is consumed during the silicidation process. Therefore, the 15 Å/minute rate is clearly much lower.

As such, Applicant continues to argue that Berti et al. does not show the etch rates described in the pending claims and actually shows rates that are much lower than the claimed rates used according to the present invention. Further, the etch rates of Berti et al. lead away from a method using higher etch rates, especially considering the Examiner's suggestion that the solutions are to be diluted with deionized water (see page 3 of Office Action last paragraph).

As stated in MPEP Section 2141.02, when dealing with obviousness type rejections, the Examiner must consider a prior art reference "in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention." Such disclosed etch rates of Berti et al. cannot be ignored especially considering the large difference between the etch rates disclosed and the etch rates claimed.

For at least the above reasons, claim 46 is not obvious in view of the cited references.

Claims 51-59

Claims 51-59 are not *prima facie* obvious in view of the cited references for the same reasons as described above by reason of their dependency on claim 46.

Further, claims 51-59 recite additional elements that further support patentability when combined with claim 46. For example, claim 53 recites that the solution includes a ratio in a range of about 1:1:35 (mineral acid:peroxide:deionized water) to about 1:1:5 (mineral acid:peroxide:deionized water). As admitted by the Examiner, neither Hayashi et al. nor Berti et al. teaches solutions that include deionized water. However, the Examiner alleges that it would have been obvious to one of skill in the art to dilute the solution with an appropriate amount of

deionized water, creating a concentration of mineral acid and peroxide that would optimize the removing process of metal nitride and cobalt against the cobalt silicide. Applicants traverse this allegation and submit that Berti et al. teaches away from this alleged motivation when considering the etch rates claimed.

In other words, the Examiner continues to assert that (as generally summarized by the Applicant) using deionized water to prepare any solution would be obvious and that routine experimentation would provide the etching rate claimed. However, as stated above, Berti et al. teaches an etch rate for titanium nitride that is much lower than the claimed etch rate. Diluting the solution taught by Berti et al. with deionized water, as is suggested by the Examiner, would cause the etch rate for titanium nitride to decrease, thereby becoming even further slower than the etch rate recited. Therefore, one skilled in the art would not be motivated to dilute the solution taught by Berti et al. to provide the present invention. The Examiner continues to fail to address such lack of motivation.

For at least the above reasons, Applicants submit that claims 46 and 51-59 are not *prima facie* obvious in view of the cited references. Reconsideration and withdrawal of this rejection are, therefore, respectfully requested.

Allowable Subject Matter

Applicants acknowledge the allowance of claims 60-88.

Response to Arguments

The Examiner's response to applicants' arguments are with respect to claims 60-67. As such claims 60-67 have been deemed allowed by the Examiner, such response to arguments will not be further addressed herein.

Summary

It is respectfully submitted that the pending claims are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicants' Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for
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CERTIFICATE UNDER 37 CFR §1.8:
The undersigned hereby certifies that the Transmittal Letter and the paper(s), as described hereinabove, are being transmitted by facsimile in accordance with 37 CFR §1.6(d) to the Patent and Trademark Office, addressed to Assistant Commissioner for Patents, Mail Stop AF, P.O. Box 1450, Alexandria, VA 22313-1450, on this 5th day of January, 2004, at 1:40pm (Central Time).

By: _____
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